

**POLISTES WASPS (HYMENOPTERA: VESPIDAE) SHOW
INTERFERENCE COMPETITION WITH OTHER
INSECTS FOR *KERMES* SCALE INSECT
(HOMOPTERA: KERMESIDAE) SECRETIONS**

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Abstract.—Twenty-one marked *Polistes fuscatus* (F.) females repelled other insects from kermesid scale insects *Kermes kingi* Cockerell for from 1 to 4 days. These wasps drove away conspecifics and other insects in at least eight other families that attempted to feed on scale secretions. When flower nectar became abundant, *P. fuscatus* and other insects except ants abandoned the scales and visited flowers.

Hymenopterans show different degrees of association with their lepidopteran and homopteran trophobionts (Wilson, 1971). For example, Darwin (1859) noted that ants obtain "sweet excretions" from "aphides"; later investigators have found that ant species are either facultative or obligative associates with aphids (Auclair, 1963; Way, 1963). Some ants protect their aphid herds from parasites and predators (Nault et al., 1976) and exhibit interference competition (Case and Gilpin, 1974) in driving away other honeydew-feeding insects. Wasps also feed on homopteran honeydew as reported by Jirón and Salas (1975), Salas and Jirón (1977), and Barrows (1978). However, there appears to be no literature regarding the vespid wasp *Polistes fuscatus* (F.) feeding on "honeydew secretions" of kermesid scale insects *Kermes kingi* Cockerell; hence, I report my findings concerning this subject. These wasps showed long-term (over 24 hr) individual constancy to these scales; and like ants, they showed interference competition with other insects when chasing them away from the scales.

MATERIALS AND METHODS

Field observations were made on the property of the University of Michigan Biological Station, Cheboygan County, Michigan; the study site is described by Barrows (1978). I observed individual *P. fuscatus* for periods of at least 15 min from one to six times per day between 0600 and 2300 hours

on almost every day from 25 July to 4 August 1977. Wasps were individually marked on their scuta with fast-drying enamel paints while they guarded or took food from scale insects. Nests of marked wasps could not be found. Branchlets of *Quercus rubra* L. with scales were also individually marked with paints. In 1978 from mid-June to mid-August, I did not find *P. fuscatus* on the same saplings where they were found in 1977 nor on hundreds of other saplings in the area. In 1978, the saplings that were examined in 1977 harbored *K. kingi* that were tended by ants; and *K. kingi* were somewhat common on nearby saplings. Means, standard deviations, and medians are given in parentheses after ranges.

RESULTS AND DISCUSSION

Wasps visited *K. kingi* on only a few saplings in a stand of hundreds, even though *K. kingi* were on dozens of saplings. Twenty-one marked wasps were seen from 1 to 5 days (2.8 ± 1.30 , 3) (Table 1 and Fig. 1). Wasps were constant to particular scale groups for from 1 to 4 days (2.1 ± 1.06 , 2) and were present both day and night. Wasp-U was seen at scale group-15 on 29 and 31 July but not on 30 July; however, in the data compilation, she was assumed to be at group-15 for 3 successive days. In three cases, two marked wasps were at the same scale groups (on branches-4, -12, -14) at different times of the same day. Nine wasps were at two or three different scale groups during the study period.

Wasps guarded 17 branchlets with from 1 to 18 scales (4.8 ± 4.40 , 3). Distances between the closest edges of the most distant scales in each guarded group were from 0 to 67 mm (18.7 ± 23.74 , 4). The "groups" contained only one scale, only scales that touched one another, or at least two scales that did not touch one another. Defended groups were from 14 to 92 cm (54.2 ± 25.28 , 53) above the ground. Altitudes of scale groups were approximated by measuring distances from the ground to the center of the highest scale in a group. For a statistical analysis with equal sample sizes, I located another 17 branchlets with unguarded scales that were less than 1 m above the ground, and on the same saplings that had wasps or on nearby saplings. These branchlets had from 1 to 7 scales (2.4 ± 1.73 , 2), and individuals or groups of scales were from 14 to 95 cm (58 ± 29.32 , 59) above the ground. Distances between the edges of the most distant scales in each unguarded group were from 0 to 80 mm (15.9 ± 24.21 , 2). There were no significant differences between number of scales in guarded and unguarded groups ($P > 0.05$, Mann-Whitney U-test). Furthermore, the data did not show even trends toward correlations between duration of wasp constancy and number, altitude, or dispersion of scales, so they were not subjected to regression analysis. Thus, from these data, it is not evident why wasps chose certain scale groups rather than others. Other factors such as secre-



Fig. 1. A female of *Polistes fuscatus* guarding six *Kermes kingi* on a branch of *Quercus rubra*.

tion quality and quantity of the scales should be examined in view of the facts that honeydew of coccid scales is known to differ slightly during the season, and the frequency of honeydew secretion varies among larval instars (Takaki and Kawai, 1966; Kawai and Takaki, 1969).

Polistes fuscatus showed interference competition with other insects for scale secretions. These wasps fought with and warded off many insects that landed or crawled near the scales, e.g., *Episyron quinquenotatus* (Say), *Evagetes subangulatus* (Banks), and other pompilid wasps; *Camponotus noveboracensis* (Fitch), *Formica subsericea* (Say), and *Myrmica brevispinosa discontinua* Weber ants; *Vespula*, chrysidid, chalcidoid, evaniid, and eumenid wasps; calliphorid and other flies; and other *P. fuscatus* of un-

Table 1. Locations of individually marked *Polistes fuscatus* (A-U) on oak branchlets with *Kermes kingi*. UM's refer to unmarked wasps.

Branch- let	No. <i>Kermes</i>	July							August		
		25	26	27	28	29	30	31	1	2	4
1	8	A	A	A	-	-	-	B	UM	-	-
2	3	C	-	-	-	D	-	-	-	-	-
3	4	E	E	E	-	-	-	-	-	-	-
4	1	F	F	-	G, H, UM	G	UM	-	-	-	-
5	3	I	I	I	-	-	-	-	-	-	-
6	3	J	J	-	-	UM	-	-	-	-	-
7	3	K	K	F	L	L	L	L	UM	-	-
8	8	M	UM	G	UM	A	-	-	-	-	-
9	10	N	N	N	N	-	-	-	-	-	-
10	8	O	O	O	O	-	-	-	-	-	-
11	18	UM	UM	-	-	P	-	D	-	-	-
12	1	-	Q	F	R	R, O	UM	UM	-	-	-
13	2	-	R	R	-	UM	UM	UM	S	S	UM
14	2	-	T	T, Q	UM	-	-	-	-	-	-
15	3	-	-	-	-	U	-	U	-	-	-
16	2	-	-	-	-	O	S	-	-	-	-
17	2	-	-	-	-	O	S	-	-	-	-

known relationships to scale defenders. *Polistes fuscatus* may have driven away parasites of *K. kingi* because chalcidoid wasps are parasites of Kermesidae (D. W. Miller, personal communication). These wasps defended the scales by landing near intruders, chasing, trying to bite, or biting them. They tended to guard only the spaces that were encompassed by scale groups. Two marked *P. fuscatus* (O, Q) that guarded particular scales for at least 1 day previously retained their scales after fights with conspecific wasps that vied for the scales.

On 5 August 1977, and during the following week, I found no *P. fuscatus* at scales. However, most scales that were abandoned by the wasps were tended by ants which indicated that the scales were still producing honeydew. Wasp visitation of scales may have been related to a scarcity of floral nectar during the unusually hot, dry summer of 1977. During the study period, there were very few wildflowers in bloom within 500 m of the study site. In late July, many *Solidago* and *Mentha* began to bloom, and by early August *Solidago* was frequently visited by *P. fuscatus* and other hymenopterans that imbibed its nectar. One marked *P. fuscatus* was found on *Solidago*. Wasps may have left the scales because flowers were a higher quality resource. It is unclear why *P. fuscatus* were not seen at scales in 1978;

however, extreme summer drought did not prevail in this year, and wildflowers were more common. In this year, *P. fuscatus* licked aphids on *Asclepias syriaca* L.

In conclusion, this investigation revealed an apparently previously unreported type of interference competition involving *Polistes* wasps and other insects that feed on kermesid scale honeydew. Continual or continuous food production over many days by scales evidently made it worthwhile for wasps to visit and guard them during nectar scarcity. The wasps stood over or near scales and repelled conspecifics and other insects. They did not appear to waste time and energy in protecting spaces that were larger than those that contained particular scales, and they apparently left scales when floral nectar became abundant. It is likely that the wasps were opportunistic users of the honeydew in 1977 and that they are not usual associates of the scales.

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